Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Nonlinear Phenomena in Trajectories of Spherical Drops with Incompressible Surfactant in Combined Buoyant and Marangoni-induced Motion MICHAEL ROTHER, University of Minnesota Duluth — We consider the interactions of two sedimenting, spherical drops in a temperature gradient with negligible thermal convection. The drops are covered with a nearly uniform surfactant film. When drop and surrounding fluid inertia are insignificant, as indicated by small Stokes and Reynolds numbers, respectively, the governing equations are linear, and the trajectories are symmetric. In the linear case, it is possible for two drops to fall as a pair with constant horizontal separation, but the drops must have the tandem arrangement initially. Moreover, a saddle point can occur in the trajectory phase plane. When drop inertia is considered, as measured by a finite Stokes number, with surrounding fluid inertia still unimportant, the governing equations become non-linear, and the trajectories lose symmetry. Asymmetric limit cycles can be observed. In addition, trajectories with a constant, finite horizontal gap become stable, with the drops oscillating into the final steady state arrangement. Retrograde motion is also possible. For small water drops in air, at a fixed drop radius and size ratio, the collision efficiency vanishes, depending on the relative strength and orientation of the gravitational and thermocapillary driving forces.

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Date submitted: 31 Jul 2019 Electronic form version 1.4